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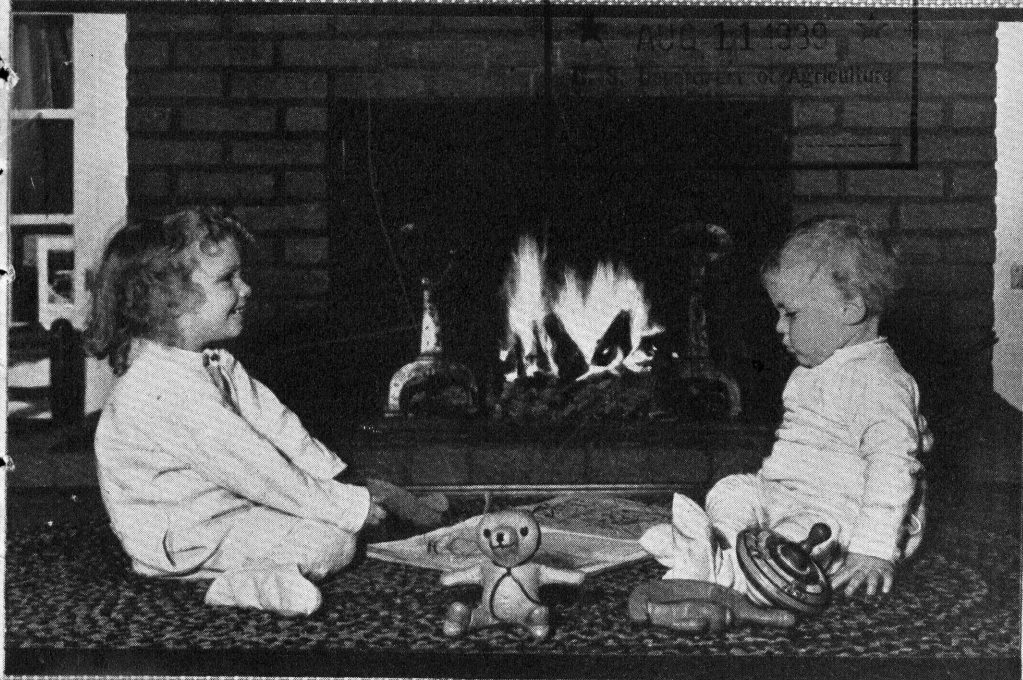
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FIREPROOFING

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U. S. DEPARTMENT OF AGRICULTURE



FABRICS

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FARMERS' BULLETIN No. 1786
U. S. DEPARTMENT OF AGRICULTURE

THIS BULLETIN gives a brief explanation of the action of various fireproofing agents and points out the good and bad qualities of the ones more commonly used. Various formulas for preparing the fireproofing solutions are given, together with directions for applying them. A mixture of boric acid and borax is most highly recommended because this mixture not only fireproofs fabrics but prolongs their serviceable life. As the fireproofing materials are soluble in water they are removed from the fabric by laundering and by rain.

Washington, D. C.

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FIREPROOFING FABRICS

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IMPORTANCE OF FIREPROOFING

FARM FIRES take more than 3,500 human lives each year. Anything that can be done to lessen this tragic loss even to a slight extent should be given serious consideration. Fireproofing children's clothes, window curtains, draperies, and other inflammable household fabrics will help to reduce the fire loss.

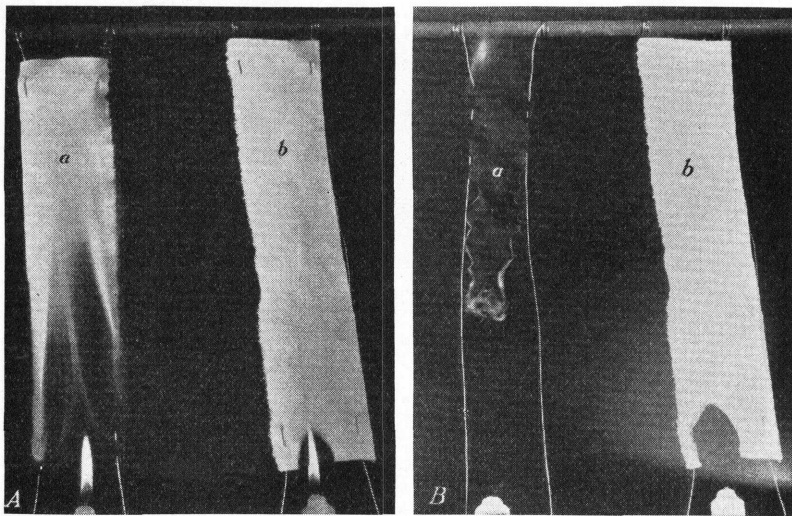


FIGURE 1.—A, Strips of cotton cloth 20 seconds after application of candle flame: *a*, Untreated; *b*, fireproofed. B, The same strips after candle flame had been applied for 1 minute: *a*, Untreated; *b*, fireproofed.

Cotton fabrics and other fabrics composed largely of cellulose catch fire easily, and fireproofing such materials is more important than fireproofing wool and silk fabrics, which burn less readily. But fireproofing both cotton and wool fabrics would reduce the fire hazard. Fireproofing treatments do not make the treated materials 100-percent fireproof since, as shown by figure 1, heating chars and destroys the

¹At the time the work was done, the author was in the Industrial Farm Products Division.

usefulness of fireproofed materials. Effective fireproofing, however, does prevent the spread of flame and thereby removes the fire hazard.

What materials should be fireproofed? Certain types of clothing, and such readily inflammable fabrics as curtains, rugs lying before open fireplaces or near living-room stoves, fabric panels used to hide the supply of wood or coal for the fireplace, fabric heat deflectors for stoves, draperies near flues or open fires, canvas fire-smothering blankets, ironing-board covers (fig. 2), cloth pot lifters, and trim-

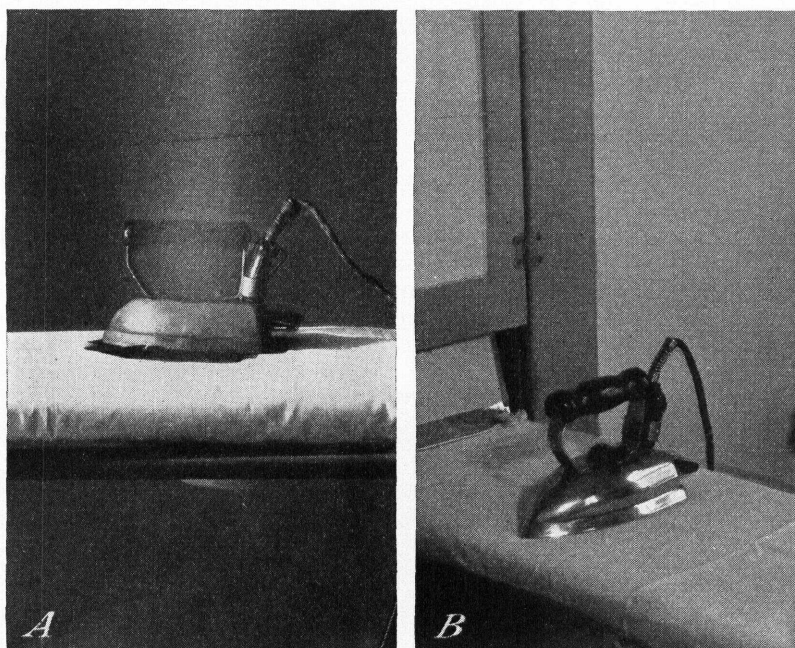


FIGURE 2.—A, A forgotten electric flatiron may ignite the ironing-board cover; B, fireproofing the cover removes this common fire hazard.

mings for Christmas trees. Fireproofed loose cotton makes a very effective insulating material for use in building construction. Fireproofed sawdust also affords effective insulation when spread over the ceilings in unfinished attics, through which heat losses are ordinarily very great.

QUALITIES OF A DESIRABLE FIREPROOFING TREATMENT

Fireproofing treatments for use in the home should be easy to apply, require little equipment, preferably that usually found in the home, and use materials which are easily obtained.

If the amount of agent required weighs more than 40 percent of the weight of the fabric or other material to be fireproofed, it is not a desirable fireproofing agent. Because of the cost and the effect on the material, it is not advisable to use as an agent any substance the required amount of which weighs more than 20 percent of the weight of the material to be fireproofed.

The fireproofing material should not shorten the life of the article on which it is used.

It should exert little or no effect on the appearance and feel of the article treated.

It should have no effect on color.

It should be stable, noncorrosive, noncaustic, and nonpoisonous, and it should not take up water.

It should adhere well.

It should be cheap.

Finally, of course, it should impart satisfactory fire resistance.

PRINCIPLES OF FIREPROOFING

Most chemical agents which possess fireproofing properties can be classified in two groups, based on the manner in which they bring about fireproofing. One group is composed of agents that smother a fire in much the same way as does carbon tetrachloride or carbon dioxide, both of which are used in fire-extinguishing devices. This action consists in decreasing the oxygen supply by diluting the air in the vicinity of the flame with gases that do not support burning.

Another group includes chemical materials that melt when heated and seal off the fibers of the fabric treated. The fireproofing effect is only partly due to the sealing action, because some parallel, assisting action goes on simultaneously. A mixture of 30 percent of boric acid and 70 percent of borax belongs in this group. When heated, it melts and completely covers the surface of the fabric treated with an unburnable film, but at the same time it gives off moisture in the form of steam, which helps to fireproof the material.

Some fireproofing materials fall into both the first and second groups. Such compounds are especially effective.

Some fireproofing agents do not fit into any of these groups. Tin oxide, one of the most typical and most effective of these, is one of the few that are not removed by rain or weather. But it cannot be introduced into fabrics by the simple processes suitable for use in the home, and therefore it is not considered in this bulletin. For further details in regard to the use of this material the reader is referred to United States Patents Nos. 1961108, 1990292, 2012686, and 2017805. Copies of these patents, which are dedicated to the public, may be purchased from the Commissioner of Patents, Washington, D. C., at 10 cents a copy.

FIREPROOFING PROCEDURES

Fireproofing treatments that can be applied in the home or on the farm are extremely simple. Fortunately, the best treatments are the simplest. All of them consist merely in dissolving the proper quantity of the fireproofing substance in a specified amount of water and saturating the goods with the solution. Several procedures may be employed, depending on the article to be treated.

Some articles can be treated by being dipped into the solution, squeezed through a clothes wringer or by hand (fig. 3), and hung up to dry just as clothes are customarily dried. It is not advisable to treat fabrics already wet, as the moisture already present prevents the absorption of enough of the fireproofing solution to insure resistance to fire.



FIGURE 3.—Fireproofing an ironing-board cover by dipping it into the fireproofing solution and squeezing it as dry as possible by hand.

If it is not desirable to dip the article into the fireproofing solution, it can be hung up, sprayed with the solution (fig. 4), and allowed to hang until dry. A common garden sprayer can be used. With this procedure, the amount of wetting can be controlled, and the necessity of squeezing out the excess solution is avoided. The

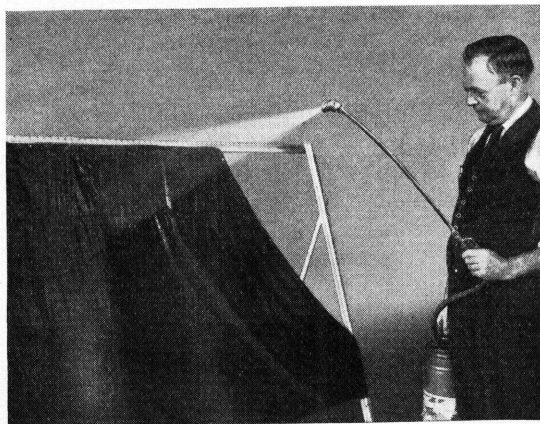


FIGURE 4.—Draperies or bulky materials can be fireproofed by spraying.

sprayer can also be used in treating such materials as carpets, loose cotton, and sawdust.

The fireproofing solution can be very conveniently incorporated in some fabrics just before they are ironed. Instead of being dampened with water, they can be sprinkled with the fireproofing solution (fig. 5) and then ironed (fig. 6). It would probably be necessary to dampen the fabric more than is customary when water is used in order to saturate it with the fireproofing solution, but the dampened fabric should be nearly dry before it is ironed. Only a moderately hot iron should be used in ironing fireproofed fabrics. If the fabric is too damp or the iron too hot, the borate mixture will deposit on the iron and make further ironing impossible. If this should happen, the deposit can be removed by wiping the iron with a clean, wet cloth.

Saturating some fabrics may be difficult—for example, new fabrics that are heavily sized and water-resistant. This difficulty can be overcome easily by incorporating in the fireproofing solution certain substances termed “wetting agents.” Ordinary soap is recommended as a wetting agent. Pure water may merely collect in drops on a water-repellent surface, but soapy water spreads and wets the same surface very effectively. Fortunately, soap is compatible with most chemicals that possess fireproofing properties. Usually just enough soap to form a suds with moderate stirring will suffice. Soap in flakes or powder form is the most convenient for this purpose.

In some cases soap may be objectionable, because it usually leaves a visible film on drying and also is made ineffective by hard water. Many wetting agents on the market are more effective, are not affected by hard water, and do not leave any visible residue on drying. These agents are used in commercial dyeing operations and can be obtained from firms handling dyers’ supplies. Very small quantities of such agents are needed. With most, one-fourth of an ounce to a gallon of solution will be enough.

For effective fireproofing, the material being treated should be thoroughly saturated with the solution. Obviously, therefore, if parts are only damp, fire resistance will not be satisfactory. In any event, it would be safer to test the procedure by treating scraps of fabric and observing the fire resistance after drying. If the fire resistance is not satisfactory, the fabric probably has absorbed too little of the fireproofing solution.

FIREPROOFING FORMULAS

Fireproofing solutions made according to the following formulas will impart satisfactory fire resistance to inflammable materials. All the solutions are prepared in the same way. The fireproofing substance is simply stirred into the water until a clear solution is obtained. In treating water-resistant fabrics, enough soap is added to the solution to form a suds. If the fabric to be treated has been laundered, probably no soap will be needed, as laundering removes sizing and makes the fabric absorbent.

FORMULA 1

Borax.....	7 ounces.
Boric acid.....	3 ounces.
Water (hot).....	2 quarts.



FIGURE 5.—Fireproofing a curtain by sprinkling it before it is ironed.

The proportions for formula 1 are shown graphically in figure 7. If powdered boric acid is used, it can be dissolved more readily by first making a paste with a small quantity of the water. Hot water should be used in preparing this solution.

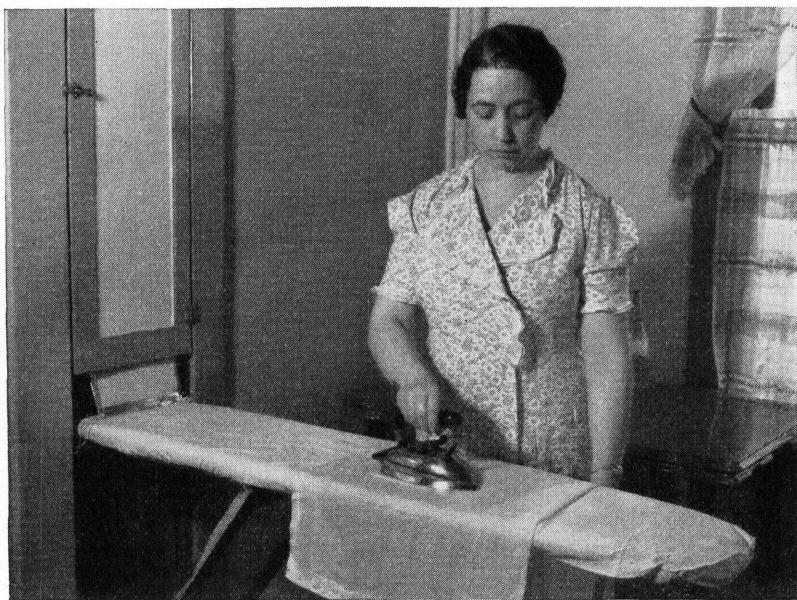


FIGURE 6.—Ironing the curtain shown in figure 5.

If allowed to stand, this borate solution will usually become turbid and sometimes jellylike, but warming will quickly restore it to its original condition.

FORMULA 2

Ammonium sulphate----- 1 pound 9½ ounces.
Water----- 1 gallon.

If fertilizer-grade ammonium sulphate is used, strain the solution to remove dirt and debris. It is further recommended that just enough household ammonia be added to the solution to impart a distinctly ammoniacal odor. This will neutralize any free acid and temporarily retard the setting free of acid which causes deterioration.

FORMULA 3

Diammonium phosphate----- 2 pounds 1½ ounces.
Water----- 1 gallon.

FORMULA 4

Ammonium sulphate----- 12½ ounces.
Diammonium phosphate----- 12½ ounces.
Water----- 1 gallon.

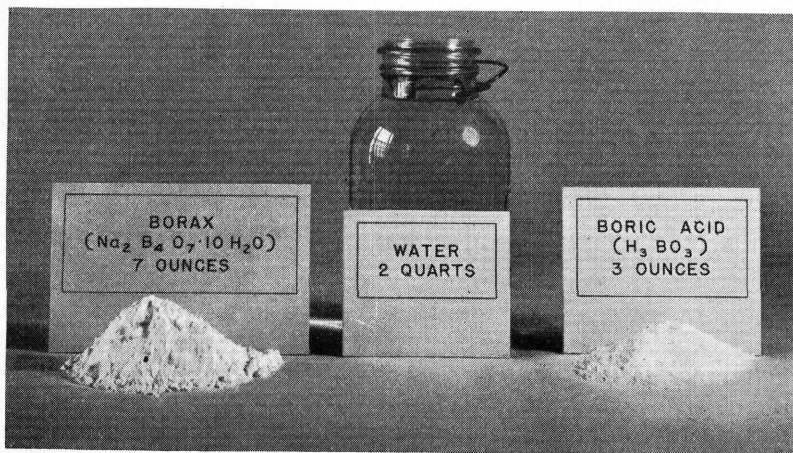


FIGURE 7.—Proportions of ingredients used in making a borax-boric acid fireproofing solution for household use.

In general, it will be found that one of the above formulas can be used on any material which is adapted for fireproofing in the home. Only formula 1 is recommended for clothing and household fabrics. Formulas 2, 3, and 4 may be used when the effect on tensile strength is not important as, for example, on sawdust, fiberboard, and loose cotton for insulating purposes.

Formula 1, the mixture of boric acid and borax, is one of the best fireproofing materials because the two compounds interact to give the solution just the properties needed to provide effective fireproofing.

Two English chemists² have found that the fireproofing properties of a mixture of boric acid and borax are most pronounced when 3

² RAMSBOTTOM, J. E., and SNOAD, A. W. THE FIREPROOFING OF FABRICS. [Gt. Brit.] Dept. Sci. and Indus. Research, Fabrics Co-ordinating Research Comm. Rept. 2; 16-94, illus. 1930.

parts of boric acid are combined with 7 parts of borax. From almost all standpoints the 3:7 mixture of boric acid and borax has the most to recommend it for fireproofing in the home. Everyone is

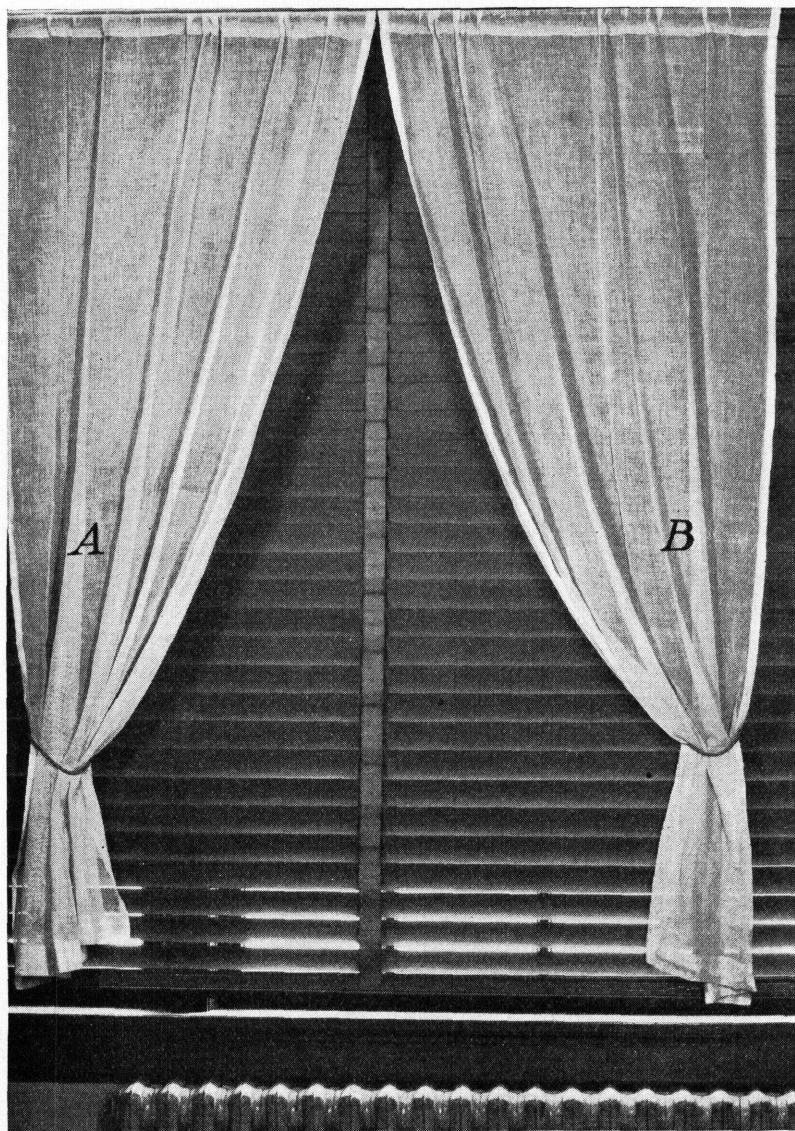


FIGURE 8.—Untreated and fireproofed curtains: *A*, Untreated curtain; *B*, curtain fireproofed with borax-boric acid solution.

familiar with these chemicals, and every drug store sells them. The borate solution is not acid or caustic and does not injure the hands.

The mixture of boric acid and borax has other valuable properties that recommend it for use on textiles. One important factor in

the wearing out of curtains and other fabrics about the home is the absorption of acidic gases from the air. These acidic gases, which result from the burning of coal and illuminating gas, contain sulphur. All kinds of fabrics are injured by the gradual absorption of these strong sulphur acids. It was learned from special tests carried out by the Bureau of Chemistry and Soils that fabrics treated with the mixture of boric acid and borax are almost entirely protected for a considerable time from the injurious action of the acidic sulphur gases, which are usually present even though they are not noticed. Unfortunately, the borate treatment does not furnish the same protection against the destructive action of sunlight. The Bureau has found, however, that the destructive action of sunlight is no more injurious to treated fabrics than to untreated fabrics. Fireproofing curtains or other fabrics has no effect on their appearance (fig. 8).

It must be remembered that these formulas are for use only when the article treated is to be kept indoors. They are not effective when the article is exposed to the weather, as the chemicals used are easily washed out. Articles that are washed, such as curtains and children's play suits, should be fireproofed after each washing.

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